WHAT IS CLAIMED IS:

- 1 1. A method for shaping data transmitted in a communication
- 2 system, the method comprising:
- determining whether to authorize transmission of received
- 4 data having a variable size within a predetermined range, the
- 5 determination being based on whether a predetermined amount of
- a time-based variable has substantially elapsed, the
- 7 predetermined amount being related to a rate shaping
- 8 criterion, and the determination being made without regard to
- 9 the size of the received data;
- 10 authorizing transmission if the predetermined amount has
- 11 substantially elapsed; and
- determining, if transmission was authorized, a new value
- 13 for the predetermined amount that must substantially elapse
- 14 before a further transmission can be authorized.
 - 1 2. The method of claim 1 further comprising:
- 2 receiving the received data; and
- 3 transmitting the received data.
- 1 3. The method of claim 1 wherein the received data is part
- 2 of a flow.

- 1 4. The method of claim 2 wherein data are at least either
 - 2 received or transmitted in packets.
 - 1 5. The method of claim 1 wherein the predetermined range
 - 2 includes multiple packet sizes in a packet-based system.
 - 1 6. The method of claim 1 wherein determining whether to
 - 2 authorize transmission of the received data includes assessing
 - 3 a single bit vector, the single bit vector reflecting whether
 - 4 the predetermined amount has substantially elapsed.
 - 1 7. The method of claim 1 further comprising determining
 - whether the predetermined amount of the time-based variable
 - 3 has substantially elapsed.
 - 1 8. The method of claim 7 wherein:
 - the rate shaping criterion comprises an average
 - 3 transmission data rate,
 - 4 the time-based variable comprises cycles of a clock, and
 - the predetermined amount is not less than:
 - 6 (the size of the previously transmitted data) *
 - 7 (the clock's frequency) /
 - 8 (the average transmission data rate).

- 1 9. The method of claim 8 wherein the new value for the
- predetermined amount is not less than:
- 3 (the size of the received data for which transmission was
- 4 authorized) *(the clock's frequency) /
- 5 (the average transmission data rate).
- 1 10. The method of claim 1 wherein the time-based variable is
- 2 time.
- 1 11. The method of claim 1 wherein the predetermined amount is
- 2 determined after a first transmission is authorized and
- 3 completely elapses before a second transmission is authorized.
- 1 12. The method of claim 1 wherein the predetermined amount is
- 2 determined after a first transmission and only substantially
- 3 elapses before a second transmission is authorized.
- 1 13. The method of claim 1 wherein authorizing transmission
- 2 comprises queuing a packet for transmission.
- 1 14. The method of claim 2 wherein the received data are at
- 2 least either received or transmitted over a dedicated line.

- 1 15. The method of claim 2 wherein the received data are
- 2 received from a wide area network and transmitted to a port
- 3 aggregator.
- 1 16. The method of claim 2 wherein the received data are
- 2 received from a port aggregator, and transmitted over a wide
- 3 area network.
- 1 17. A computer program, residing on a computer-readable
- 2 medium, for shaping data transmitted in a communication
- 3 system, the data having a variable size within a predetermined
- 4 range, the computer program comprising instructions for
- 5 causing a computer to perform the following operations:
- determine whether to authorize transmission of the data,
- 7 the determination being based on whether a predetermined
- 8 amount of a time-based variable has substantially elapsed, the
- 9 predetermined amount being related to a rate shaping
- 10 criterion, and the determination being made without regard to
- 11 the size of the received data;
- authorize transmission if the predetermined amount has
- 13 substantially elapsed; and
- determine, if transmission was authorized, a new value
- for the predetermined amount that must substantially elapse
- before a further transmission can be authorized.

- 1 18. The computer program of claim 17 wherein:
- the rate shaping criterion comprises an average
- 3 transmission data rate,
- 4 the time-based variable comprises cycles of a clock,
- 5 the instructions for causing the computer to determine
- 6 whether to authorize transmission of the received data
- 7 comprise instructions for causing the computer to assess a
- 8 single bit vector, the single bit vector reflecting whether
- 9 the predetermined amount of the time-based variable has
- 10 substantially elapsed, and
- 11 the instructions for causing the computer to determine
- 12 the new value comprise instructions for causing the computer
- 13 to calculate the new value such that it is not less than:
- 14 (the size of the previously transmitted data) *
- 15 (the clock's frequency) /
- 16 (the average transmission data rate).
 - 1 19. An apparatus for shaping transmitted data, the apparatus
 - 2 comprising a programmable device programmed to perform at
 - 3 least the following operations:
 - 4 determine whether to authorize transmission of received
 - 5 data having a variable size within a predetermined range, the
 - 6 determination being based on whether a predetermined amount of
 - 7 a time-based variable has substantially elapsed, the

- 8 predetermined amount being related to a rate shaping
 - 9 criterion, and the determination being made without regard to
- 10 the size of the received data;
- authorize transmission if the predetermined amount has
- substantially elapsed; and
- determine, if transmission was authorized, a new value
- 14 for the predetermined amount that must substantially elapse
- before a further transmission can be authorized.
- 1 20. The apparatus of claim 19 further comprising a memory to
- 2 store data.
- 1 21. A communication system for shaping transmitted data, the
- 2 system comprising:
- means for determining whether to authorize transmission
- 4 of received data having a variable size within a predetermined
- 5 range, the determination being based on whether a
- 6 predetermined amount of a time-based variable has
- 7 substantially elapsed, the amount being related to a rate
- 8 shaping criterion, and the determination being made without
- 9 regard to the size of any received data;
- means for authorizing transmission if the predetermined
- amount has substantially elapsed; and

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- means for determining, if transmission was authorized, a
 new value for the predetermined amount that must substantially
 elapse before a further transmission can be authorized.
 - 1 22. The communication system of claim 21 wherein:
 - the means for determining whether to authorize
 - 3 transmission of received data comprises a programmable device
 - 4 programmed to assess a single bit vector, the single bit
 - 5 vector reflecting whether the predetermined amount of the
 - 6 time-based variable has substantially elapsed,
 - the means for authorizing transmission comprises the programmable device programmed to authorize transmission if the single bit vector reflects that the predetermined amount of the time-based variable has substantially elapsed, and
 - the means for determining another value comprises the programmable device programmed to determine the amount of the time-based variable that must substantially elapse before a further transmission can be authorized.
 - 1 23. The communication system of claim 21 further comprising a
 - 2 receiver to receive the received data.

- 1 24. A modified token-bucket method for shaping data
- 2 transmitted in a flow in a communication system, the method
- 3 comprising:
- 4 providing a bucket for each flow, each bucket having a
- 5 variable size depending on a size of a unit of data previously
- 6 transmitted on the corresponding flow;
- 7 accumulating tokens in each bucket at an average flow
- 8 rate for the corresponding flow;
- 9 authorizing transmission of a unit of data on a
- 10 particular flow only when the corresponding bucket is full of
- 11 tokens; and
- 12 removing all of the tokens from the bucket for a
- 13 particular flow when a unit of data is authorized for
- 14 transmission on that flow.
 - 1 25. The method of claim 24 wherein authorizing transmission
 - 2 of the unit of data on the particular flow only when the
 - 3 corresponding bucket is full of tokens comprises assessing a
 - 4 single bit vector that reflects whether the bucket is full of
 - 5 tokens.
 - 1 26. A method for shaping data transmitted in a communication
 - 2 system, the method comprising:

- 3 transmitting first data having a variable size within a
- 4 predetermined range;
- 5 waiting, after transmitting first data, until a
- 6 predetermined amount of a time-based variable has
- 7 substantially elapsed, the predetermined amount being related
- 8 to a rate shaping criterion and to the size of the first data;
- 9 and
- 10 transmitting, after waiting, second data having a
- 11 variable size within a predetermined range.
- 1 27. The method of claim 26 further comprising determining a
- 2 new value for the predetermined amount, the new value being
- 3 related to the rate shaping criterion and the size of the
- 4 second data.
- 1 28. The method of claim 26 wherein the predetermined amount
- 2 begins to elapse after the first transmission is authorized.